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BEFORE THE
POSTAL REGULATORY COMMISSION

PERIODIC REPORTING (PROPOSAL FOUR)	Docket No. RM2016-12

DECLARATION OF T. SCOTT THOMPSON ON BEHALF OF AMAZON FULFILLMENT SERVICES, INC.

November 14, 2016

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I. Introduction

I.A. Qualifications

(1) My name is T. Scott Thompson. I am a Partner in the Washington, DC, office of Bates White, LLC ("Bates White"), an economic consulting firm. I specialize in analyzing mergers and acquisitions, horizontal and vertical restraints, and alleged collusive or exclusionary conduct to determine whether they had or are likely to have an adverse effect on competition. Since joining Bates White in 2006, I have conducted antitrust analyses in connection with numerous matters for private parties and government antitrust enforcement agencies, including the Antitrust Division of the US Department of Justice (DOJ), the Federal Trade Commission (FTC), and the Competition Bureau of Canada; I also have made presentations to those same agencies on behalf of private parties. I have also assisted other Bates White economists in preparation of white papers, expert reports, and testimony, including testimony presented in Federal and State courts and before the Federal Communications Commission.

(2) I submitted testimony to the Postal Regulatory Commission on behalf of Amazon Fulfillment Services, Inc. in Docket RM2016-2.

(3) I have extensive training and experience in the field of econometrics, including regression and other statistical methods. Econometrics is the application of statistical methods to economic problems. The statistical issues involved in econometrics, including appropriate execution and interpretation of regression studies, are also common to many other branches of statistics. I have published papers on econometric methodology in peer-reviewed journals.

(4) Before joining Bates White, I served for 10 years in various positions at the Antitrust Division of the DOJ. At the Antitrust Division, I was responsible for conducting, supervising, and presenting economic analyses, and making prosecution recommendations, in antitrust investigations and lawsuits relating to mergers and

business conduct in a wide range of industries. These included, among others, securities trading, healthcare services (including hospital services), insurance, computer software, consumer products, medical equipment, meatpacking, artificial teeth, paper products, financial services, semiconductor manufacturing, Internet services, telecommunications, telecommunications equipment, and satellite television broadcasting. Because of my background and experience in econometrics, DOJ often assigned me to cases or investigations involving complex or difficult econometric issues or methods. My work included conducting econometric analyses, including regression analyses, for the Antitrust Division, assisting other DOJ experts on their econometric studies, criticizing econometric analysis done by opposing experts, and supervising other DOJ economists performing econometric analyses.

(5) I played an important role in numerous significant antitrust cases while at the Antitrust Division, including, for example, *United States v. Visa U.S.A., Inc. et. al.* and *United States v. Dentsply International, Inc*. In these and other cases I worked extensively with other expert economists and other expert witnesses retained by the government or by defendants and provided economic consulting support to Antitrust Division attorneys prosecuting alleged violations of the antitrust laws.

(6) Because of my background as an educator and researcher in the field of econometrics, I was often asked while at the Antitrust Division to serve in educational or advisory positions not generally part of the job responsibilities for most Division economists. For example, I taught and organized seminars in econometrics for other economists and for Division attorneys. I served on a panel at the FTC evaluating econometric research on the competitive effects of mergers in the petroleum industry. And I served as an advisor and consultant on investigations, competition issues and related empirical research to the Grain Inspection, Packers and Stockyards Administration of the US Department of Agriculture. I was awarded the Assistant Attorney General's Distinguished Service Award by the Antitrust Division in 2001.

(7) My position when I left the Antitrust Division was Assistant Chief of the Economic Regulatory Section.

(8) Before joining the Antitrust Division, I served on the faculty of the Department of Economics at the University of Minnesota from 1987 to 1994, where I conducted research and taught graduate-level and undergraduate courses, primarily in the field of econometrics. My research and teaching involved extensive use and examination of regression and other statistical methods.

(9) From 1978 to 1981, I worked as a junior analyst of the Congressional Budget Office, where I contributed to economic analysis of Federal programs and proposed Federal programs. This work frequently involved regression analysis of large and complex data sets.

(10) I received my PhD in Economics from The University of Wisconsin in 1989, my MA in Economics from The University of Wisconsin in 1984, and my AB in International Relations from Stanford University in 1978 (also completing requirements for the Economics major). My PhD thesis analyzed existing methods and proposed new regression methods for evaluating nonlinear models of discrete data under weak restrictions on the data process.

(11) I have published economic articles in peer-reviewed journals, such as the *Journal of Econometrics*, and co-authored a chapter in the American Bar Association Section of Antitrust Law handbook *Econometrics: Legal, Practical, and Technical Issues*. Many of these articles involve extensive examination of statistical methods.

(12) My curriculum vitae appears in Appendix B.

I.B. Assignment

(13) I have been asked by Amazon Fulfillment Services, Inc., to evaluate the analysis and arguments that appear in the Report of Dr. Kevin Neels and Dr. Nicholas Powers

("Neels and Powers Report") submitted as Exhibit A to the Comments of United Parcel Service, Inc. (UPS) dated October 17, 2016 in this docket.

(14) All of the calculations and analyses that I conducted in support of this Declaration are found in library reference AFSI-LR-RM2016-12/1 in this docket.

I.C. Summary of Neels and Powers Report

(15) Drs. Neels and Powers attack the data and analysis sponsored by Dr. Michael D. Bradley in a report submitted by the U.S. Postal Service ("Postal Service") in Docket No. RM2016-12 on August 22, 2016. In his report, Dr. Bradley calculated measures of volume and capacity for different modes of purchased highway transportation of mail using data from the TRACS system and conducted regression analysis of these measures to estimate the volume variability of purchased capacity with respect to transported mail volume for each mode of transportation. He concluded that volume variability of capacity with respect to volume is somewhat less than 100%.

(16) Drs. Neels and Powers claim that Dr. Bradley's analysis is unreliable. Their main arguments, which I address in this declaration, are as follows:

- Dr. Bradley's volume measure is subject to sampling error and does not reliably measure highway transportation volume.
- Dr. Bradley's analysis fails "to capture the true determinants of decisions regarding capacity."
- Sampling error and failure to capture the "true determinants" of capacity interact to introduce downward bias into Dr. Bradley's variability estimates.
- The magnitude of the downward bias cannot be estimated, but a simulation study shows that the bias could be substantial.

(17) Drs. Neels and Powers also include several secondary claims that I address below:

- Day of the week ("DOW") variation used in Dr. Bradley's analysis decreases sample size and "makes the problem worse." Furthermore, it is implausible that capacity can be adjusted in response to day of the week variation in mail volume, because a contractor will demand a premium rate for such arrangements.
- Professor Bradley's findings imply "economically irrational behavior" because variabilities less than 100% would lead to capacity shortages at high volumes.

(18) Drs. Neels and Powers argue that these alleged flaws in Dr. Bradley's analysis render it unreliable. Hence, the authors conclude that the existing assumption that highway transportation capacity has a variability of 100% with respect to transported mail volume should be maintained.

I.D. Summary of conclusions about the Neels and Powers Report

(19) Drs. Neels and Powers claim that Dr. Bradley's results imply economically irrational conduct. This claim reflects a misguided and misleading understanding of the definition of volume variable costs. There is nothing irrational about volume variabilities less than 100% when studying the effects on capacity and costs resulting from small (or marginal) changes in volume.

(20) The assumptions of Neels and Powers about the limited options available to the Postal Service for dealing with foreseeable and unforeseeable variations in volume are counterintuitive and unsupported by evidence concerning the actual load management practices of the Postal Service. Drs. Neels and Powers implicitly assume that the Postal Service has limited flexibility in responding to volume peaks. It is economically rational for the Postal Service to engage in day of the week or similar contracting of capacity, despite arguments to the contrary by Drs. Neels and Powers, and there is evidence that the Postal Service does practice this flexibility. The Neels and Powers assumptions, along with differences between Dr. Bradley's actual methodology and the one that was simulated, have the effect of causing their simulation to exaggerate the possible effects of

measurement error on regression estimates of the variability of capacity with respect to volume.

(21) Finally, the claim of Drs. Neels and Powers that sampling error in Dr. Bradley's volume measure is causing downward bias in his estimates of volume variability is also based on unreliable analysis. Drs. Neels and Powers use an unreliable "weighted volume" benchmark and rely on classical measurement error assumptions that likely do not apply in practice.

II. Dr. Bradley's results do not imply economically irrational behavior

(22) According to Drs. Neels and Powers, Dr. Bradley's findings of evidence for less than 100% variability of capacity with respect to volume "imply economically irrational behavior."[1] Drs. Neels and Powers reason that, if the variability of capacity with respect to volume is less than 100%, then increases in volume will eventually lead to capacity shortages, "allowing the volume of untransportable mail to grow without limit."[2] Drs. Neels and Powers also observe that, if the variability is greater than 100%, then increases in volume will "allow capacity utilization to fall without limit."[3] While the conclusions that Drs. Neels and Powers draw from their premises are mathematical truisms, the premises are nonsensical. The volume variability of capacity does not remain constant

[1] As preface to this argument, Drs. Neels and Powers also assert that Dr. Bradley's model "fails to consider economic factors," is "devoid of economic content," and fails to capture "relevant aspects of the economic environment." These criticisms are unsupported. Drs. Neels and Powers offer no specific reasons why any of the "economic factors" they mention are relevant to the goals of Dr. Bradley's analysis, or to his specific econometric methods or findings.

[2] Neels and Powers Report p. 31.

[3] *Id.*

as volume changes, even if variability is approximately constant over small changes in volume.

(23) The marginal costs and elasticities used to define and calculate volume variable costs are *marginal* concepts—that is, they reflect how total costs (or capacity) vary with respect to *small* changes in total volume. They do not purport to explain how costs would change in response to large changes in total volume, let alone in response to *unlimited* increases in total mail volume. The likelihood that large or limitless increases in total mail volume may require nearly proportional increases in total capacity does not prove that small, or marginal, changes in total volume require proportional or close-to-proportional changes in total capacity over either a short or long time horizon.

III. The assumptions of Drs. Neels and Powers regarding "true determinants" of capacity decisions are unrealistic and ignore economically rational alternatives used by the Postal Service.

III.A. Summary of the argument

(24) Drs. Neels and Powers argue that "the volume of mail at the peak load point will generally determine the amount of capacity that is provided at each stop along that route."[4] While a rational firm undoubtedly considers peak loads in planning capacity, the relationship between expected peak volumes and planned capacity is more complex than Drs. Neels and Powers assume. Optimal planning also requires consideration of the alternatives of (1) meeting expected volume peaks by acquiring extra capacity for the expected peak periods, but not the off-peak periods; (2) meeting unexpected peak periods by acquiring options for extra capacity when needed; (3) reassigning existing capacity between routes, and rescheduling and reconfiguring routes; or (4) deferring or rerouting the transportation of some mail when volume is highest. Drs. Neels and Powers fail to

[4] Neels and Powers Report p. 28.

give adequate consideration to these alternatives, and so offer an incomplete and unrealistic description of capacity decisions.

(25) Before going further, it is helpful to recap the assumptions made about highway mail transportation in the Neels and Powers simulation model.[5] The model assumes particular volumes of mail need to be picked up and delivered each day from each of 500 random locations (50 locations in each of 10 zones) to each of the other locations. Mail destined for a different zone is routed first to a hub, then transported to the appropriate zone on an interzone route, and then delivered to its final destination by the end of the same day it enters the highway network. Using ad hoc rules, the model derives a particular route structure for each of the ten zones, and a single interzone route, and assumes a delivery schedule that involves two daily trips on each route, each involving an unrealistically large number of stops. In fact, each intrazone route stops at every location, while the single interzone route stops at every hub.

(26) The analysis fails to consider whether this design makes sense operationally. Maps of the routes simulated by the Neels and Powers model appear in Appendix A. The simulated routes are obviously inefficient.

(27) The average amount of simulated mail generated between any pair of locations in the model moves up or down in lock step across the entire network from quarter to quarter and by day of the week, but the precise levels are also subject to a certain amount of random daily variation.

(28) Finally, the Neels and Powers simulation assumes that the Postal Service (apparently using perfect foresight) contracts each quarter for a single amount of capacity on each route that precisely matches the peak volume of mail on each route across all stops and across all days in the quarter.

[5] Drs. Neels and Powers are silent about how capacity is determined in practice, except for observing that peak loads on each route matter in some unspecified way.

(29) The Neels and Powers model is highly unrealistic and specifically assumes economically irrational behavior by the Postal Service. A simplified example demonstrates the point: Suppose the Postal Service must deliver some amount of mail from a hub to each of two locations, A and B, and that the two locations are equidistant from the hub facility and from each other. The Postal Service could serve both locations with one large truck sized to match peak load on a single route visiting both locations. This truck would be half-empty after the first stop, and on average it would be 75% full over the two stops. Or the Postal Service it could send a smaller truck, 100% full, on two separate routes, each delivering to a single location, A or B. The second approach requires half the capacity (defined here as truck size times number of stops) as the first approach.[6] Adopting the first approach while ignoring the second would be economically irrational for the Postal Service. But that is exactly what the Neels and Powers simulation approach assumes. Their analysis fails to consider whether an alternative approach to the logistical problem would save money.

(30) Drs. Neels and Powers also assume, despite evidence to the contrary discussed below, that the Postal Service chooses a single capacity for each route that remains unchanged throughout the entire duration of each quarter and so irrationally ignores predictable variation in peak mail volume on individual mail routes across time. And the authors assume away other options that the Postal Service might rationally exercise to deal with peak demands on the highway transportation network to minimize costs.

(31) The Neels and Powers analysis thereby consistently fails to consider the effects of strong economic incentives for the Postal Service to use purchased capacity efficiently so as to minimize the amount of capacity purchased, and to minimize costs associated with transporting mail over the highway network, within service requirements.

[6] In this example, if one factors in return trips of the trucks and assumes they return empty, then capacity utilization is 50% on average for the large truck making three stops, and 50% for each of the smaller trucks making two stops each. Thus capacity utilization is the same overall. Nevertheless, truck size times number of stops is 50% greater using the large truck, so it is still more efficient to use two smaller trucks.

(32) The lack of realism in the Neels and Powers analysis has important implications for their claims about problems with Dr. Bradley's data. If the Postal Service smooths capacity utilization to minimize costs, the differences between total volume as measured by Dr. Bradley using TRACS data and the total of peak load volumes across individual routes will also be reduced, since the differences between peak and average loads on each route will be smaller. In the example discussed above, for example, peak and average loads are identical on each route when the more efficient route structure is used. By ignoring this effect, Drs. Neels and Powers overstate the likely effect on Dr. Bradley's analysis from using TRACS data rather than some measure of peak loads.

(33) These issues are discussed in more detail below. Section III.B discusses inflexibilities implicitly or explicitly assumed by the Neels and Powers analysis, and highlights some of the rational actions not considered by Drs. Neels and Powers that the Postal Service likely considers to smooth capacity utilization. Section III.C discusses a specific example that receives attention from Drs. Neels and Powers, namely the practice of contracting for different amounts of capacity by day of the week.

III.B. Drs. Neels and Powers ignore multiple ways the Postal Service can manage peak demands.

(34) The Neels and Powers simulation model takes demand for postal transportation and the highway network as given, assumes that the Postal Service has no control at all over peak loads on individual routes, and assumes that capacity on a route varies perfectly with the peak volume across all stop-days on the route during a quarter. Drs. Neels and Powers are silent as to whether the peak, in practice, should be measured within quarters, years, or over some other interval for purposes of measuring the volume variability of capacity. And the authors also ignore the possibility that the Postal Service responds to variation in mail volumes in a more flexible fashion than contemplated in the Neels and Powers simulations.

(35) The Neels and Powers model would make sense if a single quarterly capacity choice for each route were the only mechanism available to the Postal Service for managing peak loads on the highway network. This is an implausible assumption. In practice, the Postal Service likely has more than one tool for handling peak demands and varying capacity to ensure maximally efficient use of procured capacity, given predicted and unanticipated fluctuations in demand across time and locations. So while peak loads on a route are undoubtedly one of several factors that affect capacity on the route, advance decisions about the amount of capacity to acquire are likely made in conjunction with other actions to smooth volume and to match capacity more flexibly with peak volumes.

(36) Simple actions, not considered by Drs. Neels and Powers, can offer substantial improvements in efficiency by allowing the Postal Service to respond flexibly to a predictable peak in demand without increasing capacity across an entire route. For example, suppose a route predictably experiences consistently heavy volume on Wednesdays between two points, but not otherwise. Then the Postal Service rationally could add a new route that adds capacity between those points on Wednesdays only, permitting use of a smaller truck on the regular daily run and saving money compared with the alternative of contracting for a larger truck for all stops and days on the original route, even though the larger truck is not needed most of the time.

(37) More generally, within constraints of service needs the Postal Service may be able to:

- Delay or reroute transportation of some mail with reduced service requirements to smooth capacity needs over a temporary peak;
- Add or subtract trips on specific days (either within existing contracts or on a spot or an exceptional contracting basis) to deal with peaks or lulls in volume;
- Schedule reduced capacity in advance during certain weeks or days of the week, or greater capacity on other days of the week or weeks, to the extent that there is some predictability in the timing of volume flows;

- Move mail from one route to another (or even to other forms of transportation outside the highway network) on an ad hoc basis to reduce peak demands on a route; and/or
- Periodically reconfigure the highway network, including creating new routes or delivery schedules, to ensure the best match between available capacity and volumes.

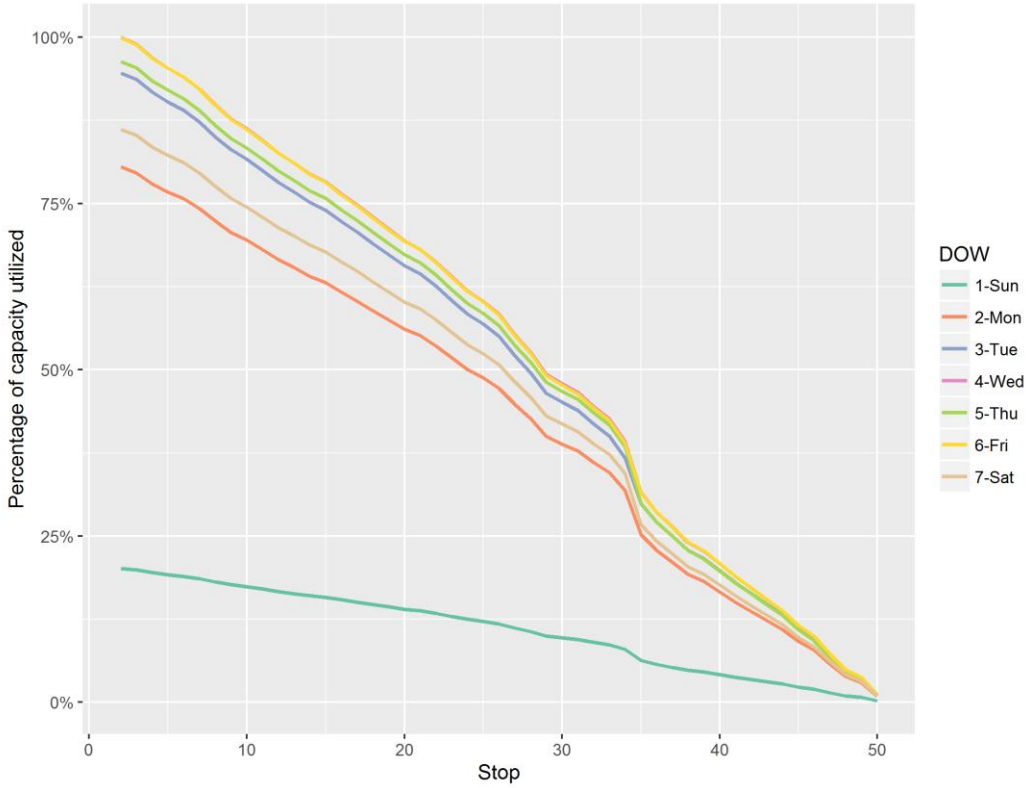
(38) Some of these actions (e.g., delaying or rerouting delivery of lower-priority mail) smooth volume across routes and days, thus reducing peak demands on each route, improving capacity utilization, and reducing differences between peak and average volumes. Other actions involve more efficient contracting to match capacity more closely to peak volumes even when volume itself cannot be smoothed.

(39) The Neels and Powers analysis and simulation, in contrast, assumes that the Postal Service uses none of these options. This assumption is counterintuitive. The Postal Service has an obvious economic incentive to purchase no more capacity than is required, given service needs, and to use the purchased capacity as efficiently as possible, given service requirements, to minimize total cost. Drs. Neels and Powers essentially assume that the Postal Service purchases capacity to deal with the maximum peak volume flows for each route in isolation and takes no other action to manage peak volumes, even if this capacity is used inefficiently most of the time, and even if mail could be delivered at lower cost within service requirements by adapting to peak flows in other ways.

(40) The lack of flexibility in the Neels and Powers model and the obvious improvements in capacity utilization that likely are available may be illustrated by considering the peak simulated mail volumes by stop in the Neels and Powers model for a single quarter and route. Figure 1 displays these peaks by day of the week and stop over the 90 days simulated for one route and quarter. This is a "part 3" route in the Neels and Powers simulation. In this scenario, mail leaves the zone A hub and is delivered to each of the other 49 locations in the zone. Since the volume of mail declines monotonically over the route each day, the peak volume coincides with the arrival of mail at the first stop. The

overall peak occurs on Fridays and Wednesdays, which have nearly identical peak volumes at each stop in this simulated quarter.

Figure 1. Peak mail volumes as a percentage of capacity, by stop and day of the week, in the Neels and Powers simulation model



Source: Analysis of Neels and Powers simulated mail volume for zone A, FY2010:Q1, part 3 route.

(41) Notably, the peak on Sundays is less than 25% of the overall peak. This means that more than 75% of the capacity needed to handle the Friday and Wednesday peak is unneeded on Sundays. Ignoring this fact would be irrational for the Postal Service. As discussed further below, contracting for Sunday capacities that matched the Sunday peak (or more generally for day of the week capacities) would likely save the Postal Service considerable money. The Neels and Powers analysis ignores this option.

(42) The Postal Service might also consider splitting this route into two routes, one serving the first 30 locations and the other serving the remaining locations. Since the Friday

peak volume at stop 30 is about 50% of the overall peak volume for this quarter, this would be a more or less even split of peak volume across the two new routes. Total capacity needed with this alternative route structure (measured as stops times peak volume) would then be about half of that assumed in the Neels and Powers analysis.[7]

III.C. Day of the week and similarly flexible contracting is rational.

(43) Another example of the inflexibility assumed by Drs. Neels and Powers involves their claim that it is "implausible" that "capacity can be adjusted in response to day to day variation in mail volume."[8] In fact, Dr. Bradley assumed only that capacity can vary by day of the week, which is a far more plausible assumption. Nevertheless, Drs. Neels and Powers argues that day of the week contracting for capacity is irrational because contractors will demand a premium price to provide different levels of capacity by day of the week, because such premiums will be required to cover the risk and transaction costs associated with this kind of contracting. Drs. Neels and Powers offer no evidence that the actual highway transportation marketplace charges significant premiums for capacity scheduled to be supplied on a less than daily frequency.

(44) Moreover, negotiating contracts that eliminate unneeded trips on some days is rational even if the per trip costs go up for the capacity that is purchased, if day of the week contracting eliminates the cost of unneeded capacity on days with predictably low volumes. Similarly, it is rational to contract in advance for less capacity than will be needed to deal with peak load demands, if it is possible to add capacity on an as-needed and temporary basis, even if the added capacity costs more per unit.

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[7] Intuitively, by splitting the route, the Postal Service would avoid purchasing capacity needed for the first 30 stops that is empty for the last 20 stops in the Brattle model. Splitting the route would also avoid purchasing capacity used on the first 30 stops to carry around mail that is not destined for any of those stops, but nevertheless goes along for the ride. The Postal Service can therefore eliminate capacity on each of the 50 stops corresponding to about 50% of the peak total amount of mail.

[8] Neels and Powers Report. p. 28.

(45) Bargaining theory predicts that per trip premiums cannot be large enough to raise Postal Service costs overall if scheduling fewer trips on some days of the week or certain dates lowers the contractor's overall costs. For example, suppose the Postal Service and a transportation contractor are negotiating whether to eliminate a trip on a day of the week when it is predictably not needed. Suppose that the net variable profit available to the contractor from an alternative use of the truck on that day is π. This figure can be adjusted downward as needed to account for any costs or risks imposed on the contractor in finding an alternative customer for the truck for that day. But the worst case for the contractor in the event the Postal Service trip is cancelled is to simply park the truck, so π cannot be more negative than the parking costs. If the trip is cancelled the contractor will also avoid costs c that would be incurred from running the Postal Service route with an empty truck.[9]

(46) As long as parking costs are less than the costs of running the Postal Service route that day[10] then the net total surplus π+c available to the parties in striking a deal to eliminate the unneeded trip is positive. Bargaining theory predicts that the parties will strike a deal to split this amount in some fashion so that both parties are better off. [11] The resulting reduction in Postal Service costs may be less than the per trip rate that would otherwise have been negotiated if the trip had been needed, and this difference might be perceived

[9] Such costs would include fuel, tolls, wear and tear on the vehicle, mileage-based maintenance costs, and labor costs.

[10] This condition seems all but certain since incremental costs of parking a vehicle likely are small and often will be zero. Furthermore, if parking costs do exceed the costs of running a trip then bargaining theory predicts that the contractor should be paying the Postal Service to run trips rather than the other way around.

[11] The surplus available to the Postal Service in avoiding an unnecessary trip will equal whatever discount on the contract the Postal Service can negotiate as a result of eliminating the trip. However, this amount is a dollar-for-dollar loss to the contractor, and so does not affect the total surplus available to both parties combined. The key insight of bargaining theory is that this amount will be negotiated to a level that offers some of the joint surplus to each of the parties, so that they are both better off than they would be absent an agreement to eliminate the trip.

as a premium on the per trip price of the trips that were not cancelled. Nevertheless it would be irrational for the Postal Service and the contractor to not reach an agreement to eliminate capacity that is predictably not required, even if doing so involves some kind of premium pricing for the remaining trips.

(47) By a parallel argument, it will be rational to add capacity on days with predictably high demand, on a temporary or ad hoc basis, even if the cost per trip of such capacity includes a premium payment, if the alternative is to pay for extra capacity on all days, even though most of the time it is not needed.

(48) As a practical matter there is ample evidence that the Postal Service does in fact adjust highway capacity on a day of the week basis. For example, 2015 TRACS data show that the number of trips per week in sampled stops varied between one and seven.[12] Analysis of the inbound and outbound routes that were under contract in FY 2009 provides further evidence. Figure 2 displays the most frequently used schedules on these routes. Daily frequency was the exception rather than the norm: Only 5% of routes were scheduled to run every day with no exceptions.[13] The four most common schedules together accounted for just over half off all routes, and none of these included Sunday transportation, as is also the case for many other routes included in the "other" category of the figure. These data suggest that the ability and incentive of the Postal Service to adjust the capacity of its highway network to day of the week-related fluctuations is not severely limited, contrary to the opinions of Drs. Neels and Powers.[14]

[12] See, e.g., variable PERWEEK in file "Inputs\Highway\pq415\sample.sas7bdat" from library reference USPS-FY15-36.

[13] Another 5% of routes in the "other" category run daily, but with irregular exceptions.

[14] Neels and Powers Report. p. 30.

Figure 2. Most frequent route schedules, FY 2009

Frequency Description	Number of routes	Percent of routes
Daily except Sundays and holidays	22,823	26.3%
Daily except Saturdays, Sundays and holidays	9,704	11.2%
Daily except Sunday and holidays other than Martin Luther King, Jr.'s Birthday, Washington's Birthday, Columbus Day, and Veteran's Day	6,517	7.5%
Saturdays except Saturday holidays	4,995	5.8%
Daily	4,219	4.9%
Daily except Mondays and days after holidays other than Martin Luther King Jr.'s Birthday, Washington's Birthday, Columbus Day, and Veteran's Day	2,471	2.9%
Sundays	1,622	1.9%
Daily except Sundays, New Year's Day, Independence Day, Thanksgiving Day and Christmas Day	1,554	1.8%
Daily except Saturday, Sunday and holidays other than Martin Luther King Jr.'s Birthday, Washington's Birthday, Columbus Day and Veteran's Day	1,524	1.8%
Daily except Sundays	1,523	1.8%
OTHER	29,698	34.3%
All	86,650	100%

Source: Analysis of data from library reference USPS-LR-N2010-8 in docket N2010-1

IV. Reasonable adjustments to the Neels and Powers analysis show that it offers no reliable evidence of sampling bias in Dr. Bradley's analysis.

(49) In this section I consider a few reasonable adjustments to the Neels and Powers simulation model. These adjustments better align the simulation with Dr. Bradley's

actual regression methodology, and also implement minor changes in simulated routing and capacity decisions that the Postal Service would reasonably consider to reduce costs in the artificial world of the Neels and Powers analysis.

(50) Although these are minor changes in the direction of better realism, they dramatically change the simulated results. The simulated bias shown in the Neels and Powers analysis is dramatically reduced by these adjustments, even with low sampling rates. I conclude that the Neels and Powers simulation study is an unreliable guide to the likely presence, direction or magnitude of any biases that might be present in Dr. Bradley's work due to use of the TRACS sample data.

(51) To be clear, these adjustments maintain the assumption of the Neels and Powers simulation model that peak loads on individual routes drive capacity and that capacity is selected to match these peak loads, and these adjustments retain most of the other unrealistic features of the Neels and Powers model. As a consequence, the small simulated biases that remain after making these adjustments do not form a reliable basis for concluding that Dr. Bradley's volume variability findings are driven by negative bias. Rather they show that in an artificial model where sampling bias is the only possible reason for a finding of less than 100% volume variability, the degree of bias likely is much less than implied by Drs. Neels and Powers.

IV.A. Effects of eliminating inappropriate use of seasonal dummy variables

(52) Figure 3 and Figure 4 show a first set of adjustments to the Neels and Powers analysis for intraregional and interregional regressions respectively. The true variability in these simulations is 100%, corresponding to a value of 1.00 in the figures. According to Drs. Neels and Powers, any deviation from this number is evidence of possible biases in their simulated world, although it could also be due in part to random deviations due to use of a fairly small set of only 100 simulated samples.

(53) The first column of results in each figure reproduces results from Tables 10 and 9, respectively, of the Neels and Powers report. Drs. Neels and Powers rely on these tables to argue that the average estimate of variability across 100 simulated sample datasets is highly sensitive to sampling rates, with the potential bias ranging from zero with 100% sampling to (negative) 92% for interregional regressions with a 1% sampling rate.

Figure 3. Intraregional regression simulations omitting seasonal dummy variables and allowing for day of the week capacities

	Average variability estimates		
Sampling rate	Neels and Powers baseline	Baseline with no seasonal dummies	No seasonal dummies and allow capacity to vary by DOW
Full population (100% sample)	1.00	1.00	1.00
10% sampling rate	0.96	0.99	0.99
2.5% sampling rate	0.83	0.96	0.96
1% sampling rate	0.65	0.91	0.92
0.1% sampling rate	0.15	0.54	0.83
Regression sample size	24	24	168
Number of simulated samples	100	100	100

Source: Bates White analysis of Neels and Powers simulated mail data

Figure 4. Inter-regional regression simulations omitting seasonal dummy variables and allowing for day of the week capacities

	Average variability estimates		
Sampling rate	Neels and Powers baseline	Neels and Powers baseline with no seasonal dummies	No seasonal dummies and allow capacity to vary by DOW
Full population (100% sample)	0.99	1.00	1.00
10% sampling rate	0.48	0.84	0.96
2.5% sampling rate	0.17	0.61	0.95
1% sampling rate	0.08	0.34	0.92
Regression sample size	24	24	168
Number of simulated samples	100	100	100

Source: Bates White analysis of Neels and Powers simulated mail data

(54) Unlike Dr. Bradley's analysis, the Neels and Powers simulated regression data are based on aggregations of the sample data to the fiscal year and postal quarter, suppressing day of the week variation. As a result, each of the Neels and Powers estimates was calculated from just 24 quarterly data points.

(55) Furthermore, unlike Dr. Bradley's approach, the Neels and Powers analysis added seasonal (i.e., postal quarter) dummy variables to the regression model. These have the effect of absorbing any seasonal variation in volume and capacity, so that the volume variability estimates are driven entirely by the variation that remains after removing these seasonal effects. Given that the simulated volume and capacity data vary more from season to season than they do from year to year, this has the effect of removing signal from the volume measurement. Since sampling error is not correlated with seasons, this also has the effect of concentrating noise from sampling in the volume regressor. Together, these effects magnify the biasing effects of sampling error by increasing the relative magnitude of sampling error compared to the part of variation in the underlying volume that is not absorbed by the seasonal dummy variables.

(56) The second column of Figure 3 and Figure 4 shows the impact of removing these dummy variables from the Neels and Powers regressions and so gives a better measure of the actual variability between volume and capacity in the simulated sample data.[15] It

[15] The Public Representative (see Comments of the Public Representative dated Oct. 17, 2016, p. 13) has argued that Dr. Bradley should include not only seasonal (i.e. postal quarter) dummy variables in his regression model, but also day of the week and fiscal year dummy variables. This proposal is misguided. Variations in volume across seasons, days of the week, and fiscal years likely are very informative about the actual degree of volume variability of capacity, precisely because volume does change significantly in these dimensions. The effect of adding these dummy variables is to remove and ignore these variations and depend entirely on the variation that remains, which may be minor and not very informative. As a result, estimates calculated in this fashion may be quite sensitive to minor noise in the data or specification errors in the regression model.

The use of dummy variables may be appropriate in some circumstances, such as to control for omitted variables. But the "omitted variable" mentioned in the Public Representative comments is volume itself, which is not actually omitted from Dr.

is clear by comparison to the first column that the estimated bias attributed to sampling error is substantially reduced by this simple change to make the Neels and Powers simulations more closely align with what Dr. Bradley actually did.

IV.B. Effects of allowing for day of the week aggregation and contracting

(57) The third column of results in Figure 3 and Figure 4 further aligns the simulated regressions with Dr. Bradley's actual regressions by aggregating the sample data by day of the week as well as by year and quarter. This expands the number of data points from 24 to 168.

(58) The original Neels and Powers simulations display 100% volume variability under 100% sampling only because they chose to aggregate sample data by year and quarter only, thus ignoring the substantial variability in volume across days of the week in their simulated data. In their simulations capacity does not change at all between Wednesday and Sunday even though volume drops on average by about 80% on Sundays. I reran their population (i.e. 100% sampling rate) regressions on their simulated data using 168 data points calculated using Dr. Bradley's aggregation method, and omitting seasonal dummy variables, and found that the estimated volume variability was 32%, not 100%, in both the intrazone and interzone regressions. Thus the characterization of the Neels and Powers simulation as representing 100% volume variability is accurate only if one ignores (as they did) the substantial variation in volume across days of the week in their simulated data.

Bradley's regressions. Dummy variables should be included only if there is good reason to believe that significant omitted variables *other than volume* are independently driving capacity. I have seen nothing in the record to suggest that that is so, and it certainly is not so in the Neels and Powers simulation model, in which volume is by design the only variable that drives capacity. Caution in the interpretation of regression results is especially needed when the dummy variables are correlated with regressor variables of interest, as occurs here.

(59) For this reason, in the spirit of Drs. Neels and Powers attempt to simulate 100% volume variability with respect to peak volumes, the regressions summarized in the third column of results in Figure 3 and Figure 4 were calculated after replacing the assumption of Drs. Neels and Powers about capacity with a more reasonable assumption that allows for day of the week contracting. Capacity was calculated to match the peak volume by day of the week on a route within a quarter in deriving the estimates in the third column of results. As previously explained, this is a reasonable approach to contracting that significantly improves the efficiency of contracting.

(60) Since there is significant variation in simulated volume across the days of the week (e.g. simulated volume is much lower on Sundays than otherwise), these changes serve to add "signal" to the data, because some of the differences in average volume between the various days of the week are large compared to any measurement error that is induced by sampling.[16] As is evident in the figures, this improvement in the signal to noise ratio of the volume variable, created by better aligning the simulated regressions with Dr. Bradley's methodology, reduces the bias due to sampling even further.

IV.C. Effects of point-to-point routing of interregional mail

(61) As previously discussed and as shown in Figure 16 in Appendix A, the Neels and Powers simulations assume there is a single route connecting the ten "zones" of their simulation. It is very unlikely that the Postal Service designs its inter-NDC or inter-SCF highway network in this fashion.

(62) One alternative possibility for longer-distance highway transportation between hubs with significant mail volume would be to run point-to-point routes between the hubs. This would significantly increase the number of routes but would also significantly reduce capacity needs on each route and likely would lower costs overall. Furthermore, with point-to-point routing, a vehicle used to transport mail in one direction could be used to

[16] This is true in the simulations even though fewer sampled data points are used to calculate each of the 168 aggregated data points used in the regressions.

backhaul mail in the reverse direction, eliminating inefficient long-distance backhaul of empty trucks. The Postal Service would need to match capacity only to the peak volume between the two points on each route (allowing for different peaks in each direction). My understanding is that the Postal Service does often use point-to-point routing between significant hubs.

(63) I reran the Neels and Powers model of interregional mail transportation with these modifications, leaving the intraregional model unchanged. Since only the interregional data were affected, I focused my attention on interregional regressions. Importantly, these changes have the effect of reducing the number of stops on each route and also reducing the asymmetry in capacity utilization between the early and late legs of each trip, and so tend to reduce any sampling error in volume measurement due to variation between stops on a trip. As a result, I expected these changes to significantly reduce the bias in the Neels and Powers simulations of interregional regressions.

(64) The results of this exercise are displayed in Figure 5. As expected, comparing the first two columns reveals a large reduction in the bias due to sampling as a result of the smoothing of capacity utilization that results from this simple change to route structure.[17] The remaining two columns show that improvements are even greater when one also eliminates seasonal dummy variables and allows for day of the week contracting, using the same approach as in Figure 4. Indeed, there is essentially no bias after these reasonable adjustments to the Neels and Powers model.

[17] A small part of the difference could be due to a need to re-run the Brattle simulation to determine the daily point-to-point mail volumes between each pair of hubs. These data were not saved in the backup materials to the Neels and Powers report that UPS filed in its library reference. On re-running the simulation, I recalculated the Neels and Powers baseline results to make sure that nothing had changed. But there were some small but statistically insignificant changes, most likely caused by minor differences in the hardware or software versions available to me versus what was used to prepare the Neels and Powers Report. These changes do not affect my conclusions.

Figure 5. Inter-regional regression simulations with point-to-point routing

Sampling rate	Average variability estimates			
	Brattle baseline	With point-to-point routing	With point-to-point routing and no seasonal dummies	With point-to-point routing, no seasonal dummies and allowing capacity to vary by DOW
Full population (100% sample)	0.99	0.99	1.00	1.00
10% sampling rate	0.48	0.90	0.98	1.00
2.5% sampling rate	0.17	0.75	0.91	1.00
1% sampling rate	0.08	0.71	0.86	1.00
Regression sample size	24	24	24	168
Number of simulated samples	100	100	100	100

Source: Bates White analysis of simulated mail data generated from an adjustment to the Neels and Powers simulation model for inter-regional mail transportation

V. Consequences of measurement error

(65) Drs. Neels and Powers argue that measurement error resulting from sampling in Dr. Bradley's regression data or other causes could introduce bias into his regression model estimates of variability. Drs. Neels and Powers offer no reliable evidence of the presence, direction, or magnitude of any such bias.[18] They admit that they cannot determine the magnitude of bias due to measurement error.[19] Furthermore, as I

[18] Drs. Neels and Powers claim that the TRACS data provide such evidence, as argued in their Table 8. That table shows that volume variability estimates rise when the data are filtered by excluding data points with low capacity utilization. This analysis, however, is uninformative about the issue, because volume variability must become closer to 100% as a matter of simple mathematics if one only uses data from tests where volume is closer to capacity. The flaw in the authors' reasoning comes from failure to recognize that excluding TRACS tests with low volume relative to capacity tends to systematically exclude trips where peak volumes are also low relative to capacity, and so would raise volume variability estimates even if there were no variation in capacity utilization across stops.

[19] "The model we have created is not similar enough to the actual Postal Service

demonstrate below, the direction of bias caused by measurement error could go in either direction, depending on the nature of the measurement errors.

V.A. Classical measurement error

(66) In their discussion of measurement error, Drs. Neels and Powers make all the assumptions that appear in textbook discussions of measurement error but provide no explanation as to why these conditions should hold for Dr. Bradley's regressions. As explained further below, these assumptions are somewhat too convenient and lead to a distorted view of the likely consequences of measurement error. To understand why, one must first understand why "classical" measurement error can lead to biases in regression models.

(67) In a simple, univariate regression of capacity on volume (with both expressed in logarithms) similar to the regressions calculated by Dr. Bradley, the slope coefficient of interest can be expressed as the ratio of the estimated covariance of capacity and volume to the estimated variance of volume. Formally, one can write the slope estimate as

$$\hat{\beta} = \frac{\widehat{\text{cov}}(\ \ln(\text{volume})\ ,\ \ln(\text{capacity})\ )}{\widehat{\text{var}}(\ \ln(\text{volume})\ )}$$

(68) This equation expresses the ratio of the sample covariance of volume and capacity to the sample variance of volume (again assuming that all values are expressed as logarithms). Suppose there is measurement error in volume and that this error is uncorrelated with the correct measure of volume. These assumptions imply an increase in the denominator of the ratio (since measured volume is "noisier" than it otherwise would be) and thus tend to reduce the estimated slope coefficient. If the measurement error is also uncorrelated with capacity, then the covariance term in the numerator will be largely unaffected by the presence of measurement error. Under these conditions, the overall

transportation network to quantify the extent of the downward bias and thus to calculated the true variability." (Neels and Powers Report. p. 47).

effect of the measurement error is therefore to reduce the magnitude of the estimated slope coefficient.

(69) This kind of "classical" measurement error is highlighted by Drs. Neels and Powers. It tends to reduce the estimated slope coefficient relative to the value that would be obtained absent any measurement errors. It could apply, for example, if Dr. Bradley's volume measurements are unbiased but noisy *and if this noise is uncorrelated with other variables in the model, including capacity, and if all other assumptions of the classical regression model are satisfied*.

V.B. Consequences of measurement error in the general case

(70) A more rigorous explanation of the effects of classical measurement error appears in many econometrics textbooks, but this does not mean that the assumed conditions are likely to be correct in any given application. "Measurement error models presented in econometric and statistical textbooks typically make strong—and exceedingly convenient—assumptions about the properties of the error."[20] A more general treatment that allows for measurement error in the dependent variable as well as a more general pattern of correlations for measurement errors in multiple variables can lead to different conclusions. A general treatment is in Bound et al. (1994).[21] It is clear from that analysis that establishing the direction and magnitude of biases created by measurement error (if any) requires knowledge about many unknown quantities that interact in complex ways.

(71) As an example of the more general case, suppose that capacity and volume are both subject to measurement error, and that these measurement errors are positively correlated. Then the estimated covariance between capacity and volume in the numerator of the previously described ratio may rise due to the positive correlation of

[20] John Bound, Charles Brown, Greg J. Duncan, and Willard L. Rodgers, "Evidence on the Validity of Cross-sectional and Longitudinal Labor Market Data," *Journal of Labor Economics 12* (1994): 345-68.

[21] *Id.*

the measurement errors in the two variables. This will mitigate negative bias in the slope estimate caused by measurement error in volume and could cause positive bias in the estimated slope coefficient instead. Thus it is possible that measurement error would cause Dr. Bradley to predict a volume variability of capacity with respect to volume that is too high rather than too low.

(72) If Dr. Bradley's regression data have measurement errors in volume due to sampling then it likely also has measurement errors in capacity that are positively correlated with the measurement errors in volume. For example, if a TRACS sample by random chance happens to have a larger proportion of large trucks than were in the population from which the sample was drawn, then both total volume and total capacity may be measured with positive error because volume on a truck likely is positively correlated with truck size. Similarly, an oversampling of small trucks may produce two negative measurement errors. Either way, the capacity and volume measurement errors would be positively correlated, mitigating bias that measurement error in volume alone would cause under the assumptions of the classical measurement error model and possibly leading to an upward bias in estimated volume variability rather than a downward bias.

V.C. The Neels and Powers simulations do not allow for significant measurement error in capacity.

(73) The oversimplified model of capacity determination in the Neels and Powers model allows little room for sampling error for capacity and so tends to "bake in" the assumptions of the classical measurement error model. This may explain why the Neels and Powers simulations do not exhibit positive bias of the slope coefficient. The same fact may contribute to their demonstration of a very large amount of negative bias when the sampling ratio is low.

(74) These simulations leave little room for measurement error in capacity as a consequence of two features: the simulations assume no variability in capacity across stops or across days within a quarter, and the number of simulated routes is very small. Since the only

variation in capacity within a quarter is across routes in their simulations, sampling error in capacity could arise only when a quarterly sample has an unrepresentative distribution of routes. But if the quarterly sample is reasonably large compared to the number of routes then the sample distribution of routes is likely to be quite accurate, and so sampling error in capacity will be minor. The measurement error in capacity will be even less to the extent that capacity does not vary much across zones within a quarter in the simulations, as is likely the case, given the symmetric setup of the model.

(75) Figures 6–8 of the Neels and Powers Report indicate that there is relatively little measurement error of capacity in the Neels and Powers simulation model. These figures show very little increase in the variability of simulated measured capacity as the sampling ratio is decreased from 100% to 1%.

VI. Drs. Neels and Powers fail to offer reliable evidence on measurement error due to sampling.

(76) Drs. Neels and Powers have not quantified the sampling error in the regression data used by Dr. Bradley. While sampling can introduce measurement error into the measurement of aggregate quantities such as volume or capacity, the tests relied on by Drs. Neels and Powers to support their claim that there is substantial error in Dr. Bradley's volume measurements leave significant room for doubt about that conclusion.

(77) As a general matter, reliable statistical inference can often be done from survey data based on low sampling rates, despite the risk of measurement error. For example, the Bureau of Labor Statistics publishes monthly estimates of employment, unemployment and labor force participation based on the monthly Current Population Survey, which samples only about 60,000 households each month out of the approximately 116 million households in the United States.[22] The sampling rate is thus roughly 1 in 2,000, which is lower than the rates reported for TRACS in Neels and Powers Table 2.

[22] United States Census Bureau web page describing CPS sampling methodology, ,

(78) The authors' claim of significant sampling error rests primarily on a test showing that Dr. Bradley's measurement of volume does not match the values obtained by Drs. Neels and Powers. They claim that their measure of volume—"weighted volume"—is reliable without providing any evidence that it is more reliable than Dr. Bradley's measure. However, it is doubtful that this "weighted volume" measure provides a reliable index of the volume carried by the corresponding purchased highway transportation contracts.

(79) At their core, the "weighted volume" measures offered by Drs. Neels and Powers are simply weighted sums of mail volume over the various classes of mail, using different weights for each highway transportation contract type. Each of these ad hoc "usage weights" is the ratio of the highway transportation volume variable cost in 2015 for the contract type that was allocated to a particular class of mail, to the total piece count in 2015 of the corresponding class of mail. The use of allocated cost to construct the "usage weights" means that the weights are sensitive to how highway transportation volume variable costs were measured and distributed to products, and further implies that the "weighted volume" described by Drs. Neels and Powers is actually a measure of cost rather than of volume.

(80) I have confirmed, in fact, that the total "weighted volume" calculated by Drs. Neels and Powers for 2015 is exactly equal to the attributed volume variable costs for FY2015, for each type of highway contract, as it must be given the method for constructing weights.[23]

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accessed Nov. 13, 2016 at http://www.census.gov/programs-surveys/cps/technical-documentation/methodology/sampling.html.

[23] I checked this identity using a "weighted volume" measure in the nonpublic backup materials for the Neels and Powers Report that is slightly different from the one described in the report itself. Specifically, I used the measure of "weighted volume" before adjustments were applied for possible differences between "regular" and "total" costs, as described on page 12 of the Report. Since these adjustments were made to correct for the "limited coverage" of the TRACS data, and not specifically to improve the volume measurement, the Brattle authors presumably would claim that weighted volume calculated using total costs is the better indicator of total volume. In any event, my conclusions about the flawed nature of the weighted volume measure stand even if the correction is applied, since the adjustments simply replace one cost

(81) The weighted volume measure could offer a reliable index for volume measured in cubic foot miles (CFM) only under special circumstances. One can show, for example, that the weighted volume measure is proportional to total CFM volume for a given mode of highway transportation if for every class of mail (1) the proportion of pieces traveling via the given mode of highway transportation is constant over time and (2) there is no variation over time in the per piece average CFM for the class of mail when it travels over the given mode of highway transportation. Neither condition seems plausible. Changes in the average size of a piece of mail within a class will cause a violation of the second condition. And shifting patterns of mailing could easily upset both conditions, especially if the Postal Service adapts over time to changing mailing patterns by re-optimizing its logistics for, and use of, highway transportation in order to minimize costs.

(82) Thus it is unlikely that measure of "weighted volume" used by Drs. Neels and Powers provides a reliable index for the volume of mail transported over the highway network.

VII. Conclusions

(83) The notion that Dr. Bradley's results imply economically irrational conduct reflects a misunderstanding of the concept of volume variable costs. Volume variabilities can be well below 100% when changes in volume are small. This is an illustration of the difference between the behavior of a function at the margin versus over a larger increment.

(84) The fundamental premise of Drs. Neels and Powers' entire analysis is their assumption that the Postal Service has limited ways to manage foreseeable and unforeseeable variations in volume. This assumption is unsupported by evidence concerning the actual load management practices of the Postal Service. The authors' claim that the day of the week or similar contracting of capacity in response to predictable variation in demands

measure with a different one.

cannot be cost effective is also unsupported. These assumptions, along with differences between Dr. Bradley's actual methodology and the Neels-Powers simulation study, cause the simulation to exaggerate the possible effects of measurement error on regression estimates of the variability of capacity with respect to volume.

(85) Finally, the claim that sampling error in Dr. Bradley's volume measure is causing downward bias in his estimates of volume variability is also unsupported by credible analysis. Drs. Neels and Powers use an unreliable "weighted volume" benchmark and rely on classical measurement error assumptions that likely do not apply in practice.

VERIFICATION

I, T. Scott Thompson, declare under penalty of perjury that the foregoing is true and correct. Executed on November 14, 2016.

Appendix A. Inter- and Intrazonal routes in the Neels and Powers model

Figure 6. Zone A population centers and intra-zone delivery route

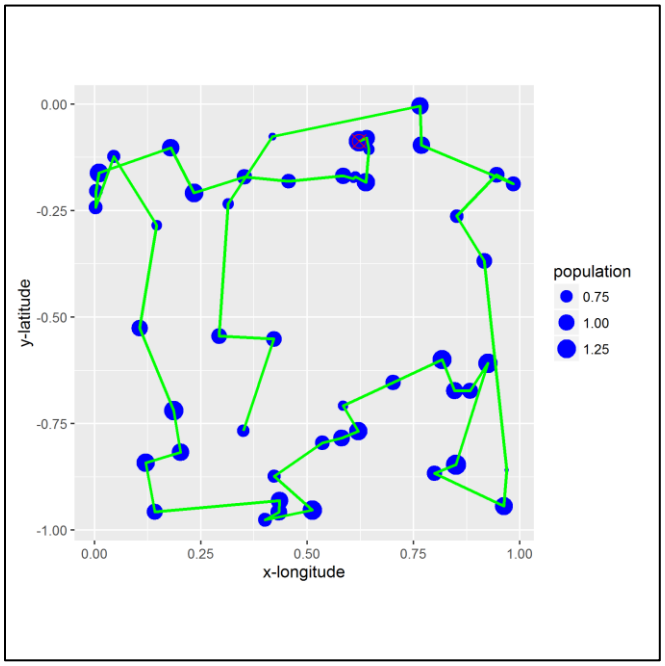


Figure 7. Zone B population centers and intrazone delivery route

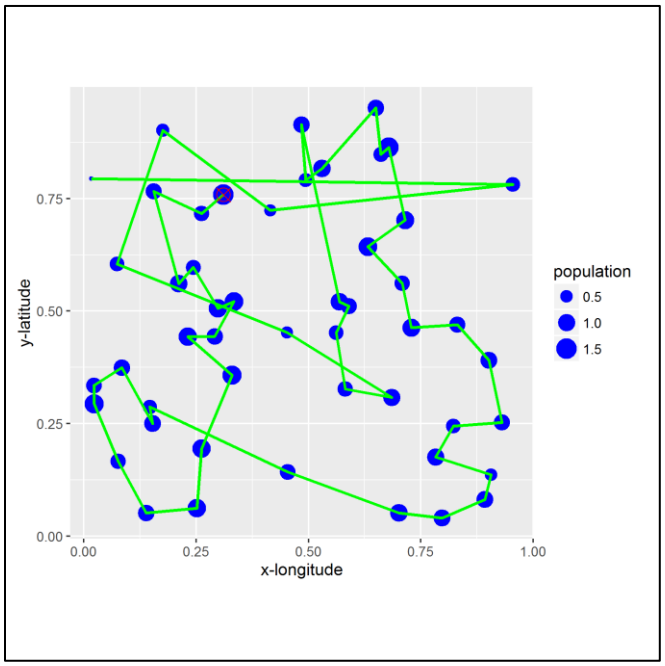


Figure 8. Zone C population centers and intrazone delivery route

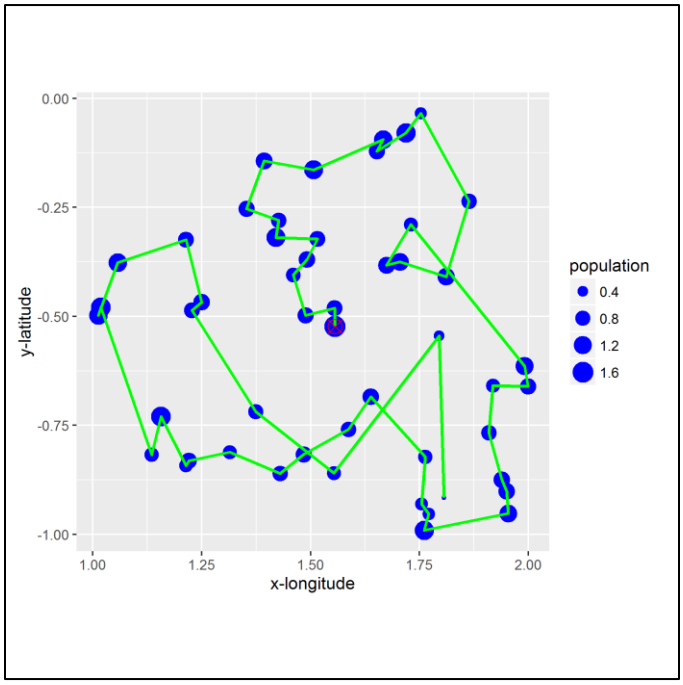


Figure 9. Zone D population centers and intrazone delivery route

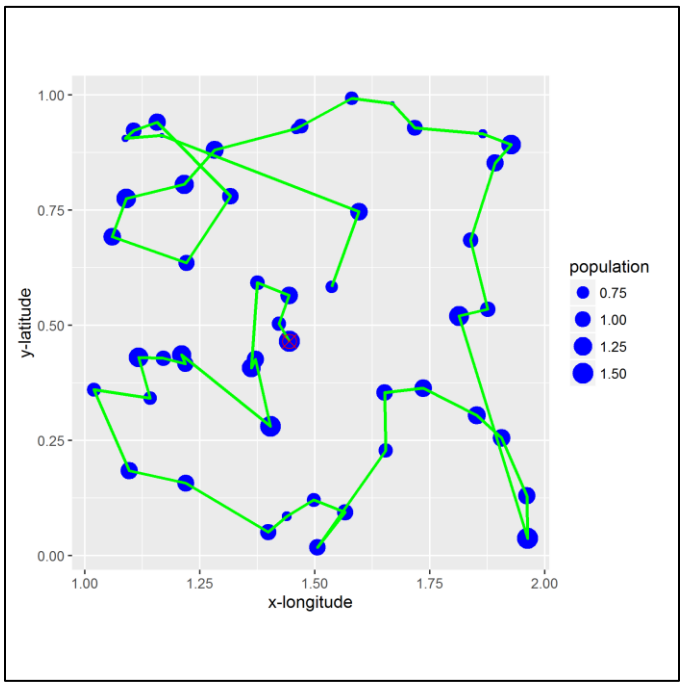


Figure 10. Zone E population centers and intrazone delivery route

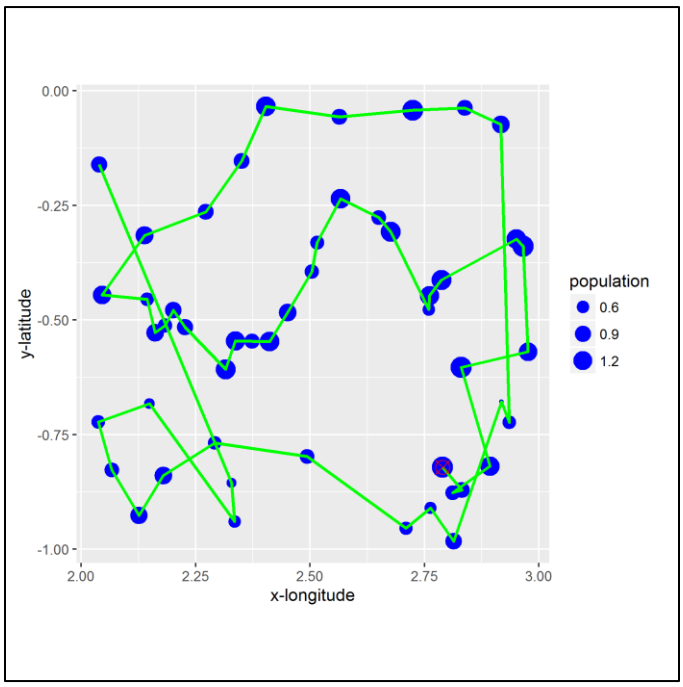


Figure 11. Zone F population centers and intrazone delivery route

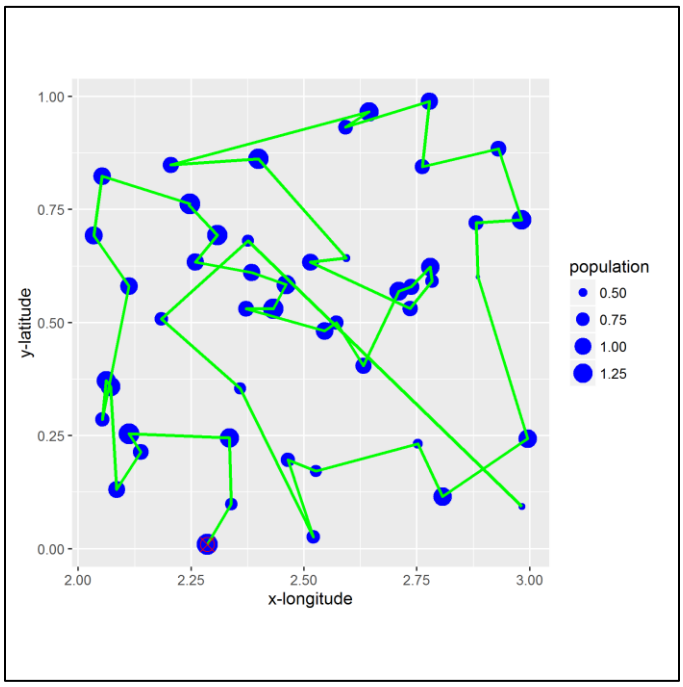


Figure 12. Zone G population centers and intrazone delivery route

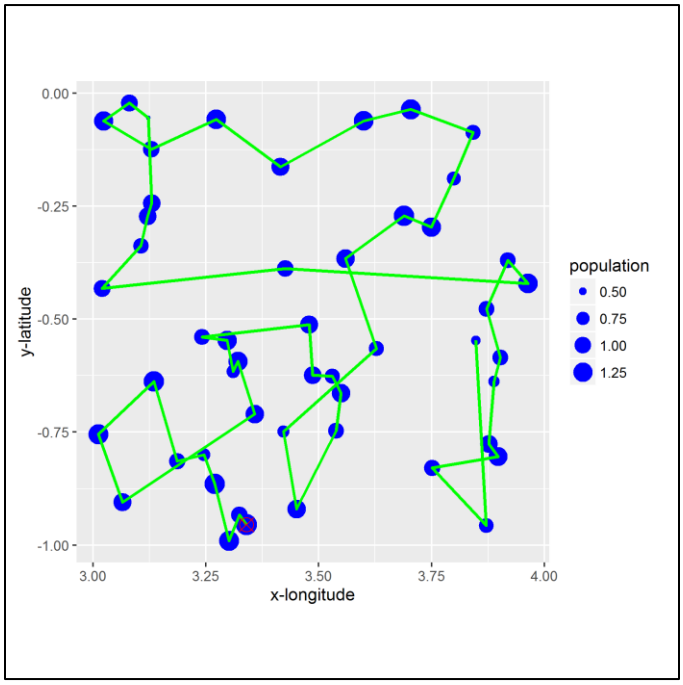


Figure 13. Zone H population centers and intrazone delivery route

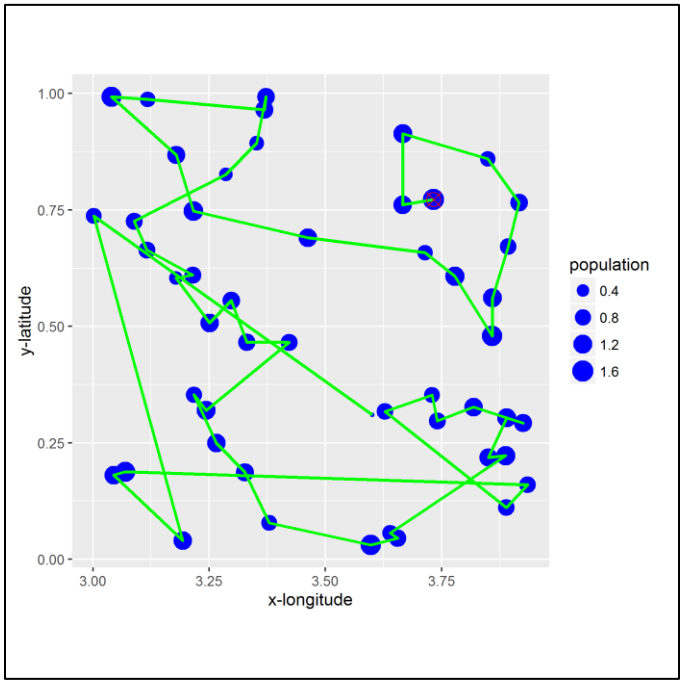


Figure 14. Zone I population centers and intrazone delivery route

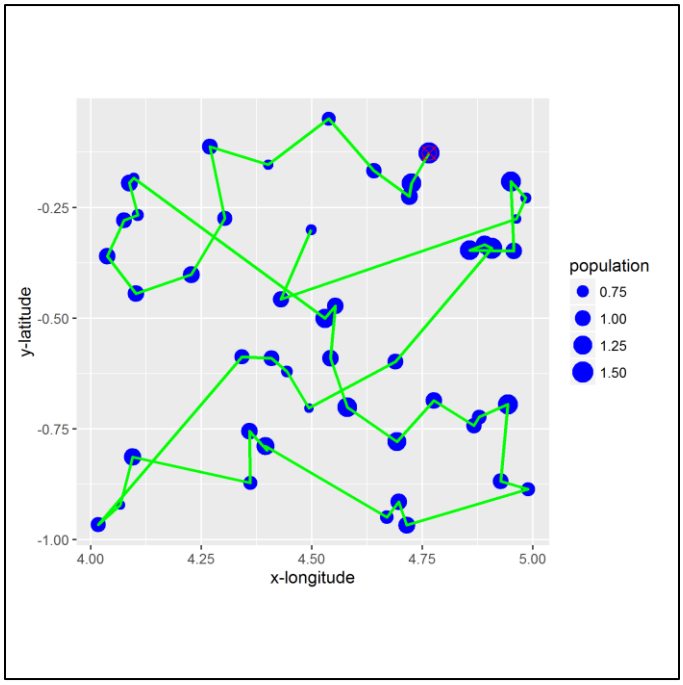


Figure 15. Zone J population centers and intrazone delivery route

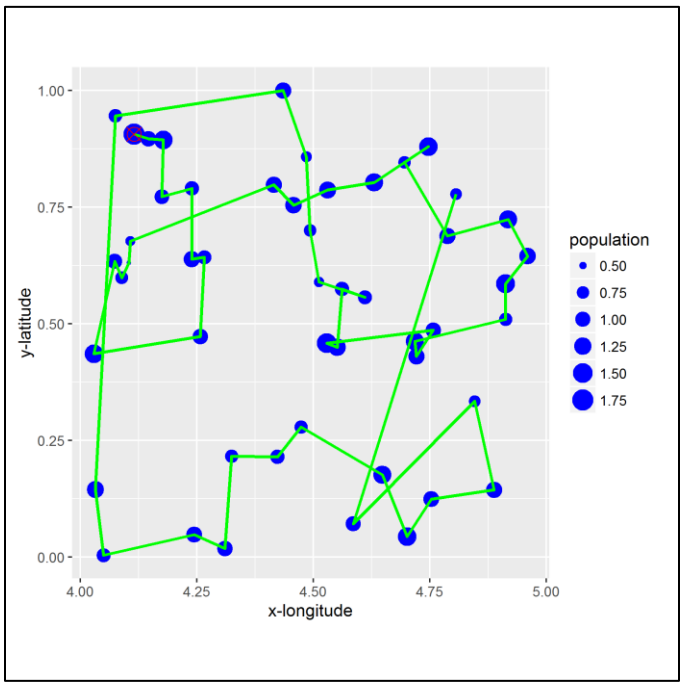
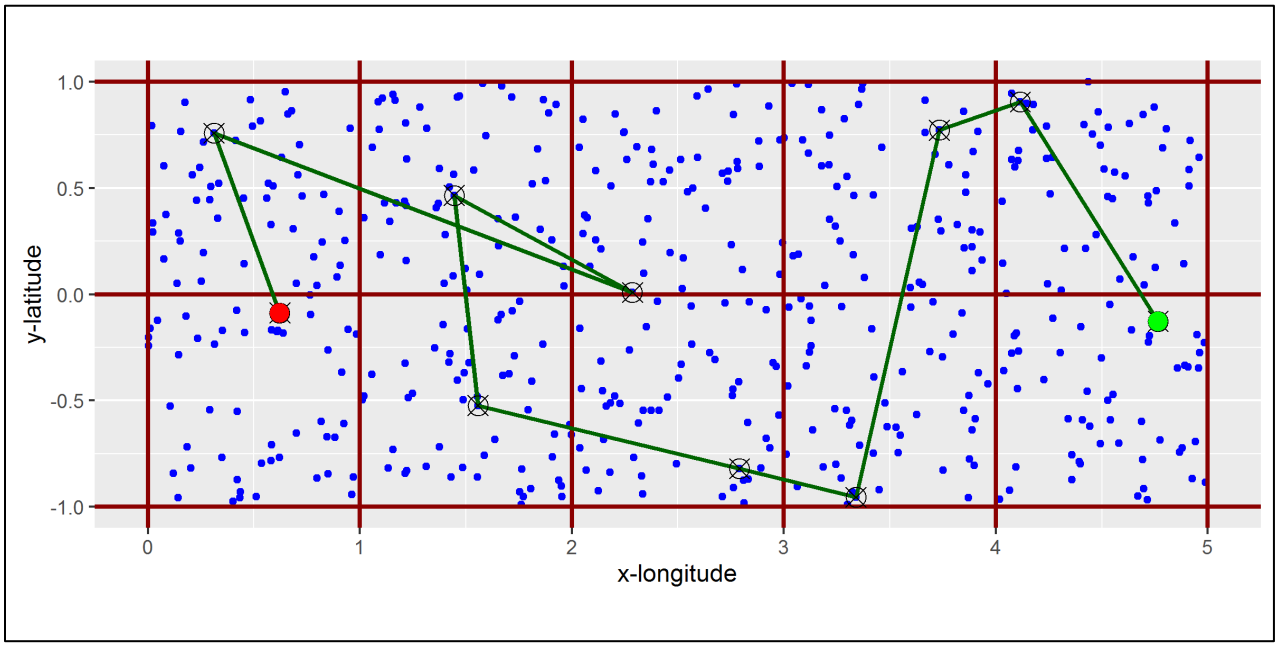


Figure 16. Overall population distribution, geography and interzone delivery route



Appendix B. Curriculum vitae of T. Scott Thompson

B.1. Summary of experience

Dr. T. Scott Thompson specializes in antitrust analysis of alleged anticompetitive conduct. He has significant methodological expertise and extensive experience using economic models and empirical techniques to assess and quantify predicted effects of proposed mergers, agreements, and single-firm conduct.

Dr. Thompson has an extensive background providing antitrust analysis in support of expert testimony and enforcement decisions. Since joining Bates White he has represented clients before the Federal Trade Commission and the Antitrust Division of the US Department of Justice, and has worked often with clients and testifying experts on matters in litigation.

Prior to joining Bates White, he served as staff economist and the Assistant Chief of the Economic Regulatory Section of the Antitrust Division. In that role, Dr. Thompson conducted or supervised the agency's economic analysis in numerous antitrust investigations in a wide variety of industries including computer software, healthcare, health insurance, investment products, payment systems, financial services, and medical technology. Dr. Thompson has extensive experience in econometrics, simulation, survey design and analysis, analysis of vertical and horizontal restraints, and merger analysis.

Prior to joining the Antitrust Division, Dr. Thompson taught and conducted research in the field of econometrics as Assistant Professor at the University of Minnesota. Over the course of his career, Dr. Thompson has contributed to the academic literature on market definition and market power, two-sided markets, theoretical econometrics, and international trade. He authored parts of the ABA Section of Antitrust Law's treatise *Econometrics* (2005).

B.2. Education

- PhD, Economics, University of Wisconsin

- MS, Economics, University of Wisconsin
- AB, International Relations, Stanford University

B.3. Professional employment history

- 2006 to present: Partner at Bates White Economic Consulting, Washington DC
- 2003–2006: US Department of Justice, Assistant Chief, Economic Regulatory Section, Antitrust Division
- 1995–2003: US Department of Justice, Economist, Economic Analysis Group, Antitrust Division
- 1994–1995: University of Wisconsin-Madison, Visiting Assistant Professor, Department of Economics
- 1987–1995: University of Minnesota, Instructor and Assistant Professor, Department of Economics
- 1981–1987: University of Wisconsin-Madison, Graduate Assistant and Teaching Assistant, Department of Economics

B.4. Selected monopolization and cartel experience

- Supported expert preparing a declaration filed with the FCC as an exhibit to a petition by T-Mobile USA requesting an expedited declaratory ruling. The declaration analyzed the possible incentives for a mobile wireless network operator to raise rival costs for wholesale data roaming services, and analyzed several pricing benchmarks that the FCC might consider in resolving disputes about whether contract terms for roaming services meet the 'commercially reasonable' standard.
- Retained to testify on economic damages on behalf of American Specialty Health, Inc. (ASH) in its exclusive dealing suit against Healthways, Inc. The two companies compete to administer fitness benefits for retirees on behalf of Medicare Advantage health plans. The parties ultimately reached a settlement in which Healthways "agreed to waive the

exclusivity provisions and other provisions contained in contracts with certain participating locations."

- Provided liability and damages analysis for DuPont in its litigation against Monsanto regarding alleged antitrust and intellectual property violations. Monsanto originally sued DuPont and its Pioneer subsidiary for infringing Monsanto's Roundup Ready soybean patent. DuPont countersued, accusing Monsanto of antitrust violations and of fraudulently obtaining the patent. The parties agreed to dismiss antitrust and patent lawsuits filed against each other as part of a broader licensing agreement reached between the two agricultural biotechnology giants.
- In two matters, *American Airlines v. Sabre* and *American Airlines v. Travelport*, led the team providing support for expert testimony on damages on behalf of American Airlines. The suits, filed in both state and federal courts in Texas, alleged anticompetitive conduct by Sabre and Travelport in the US market for airline ticket booking services. Claims asserted under both the Sherman Act and the Texas Free Enterprise and Antitrust Act alleged that defendants intended to deter American Airlines from using its "direct connect" technology to compete with the defendants' global distribution services. After one week of trial, American and Sabre settled their disputes. A settlement with Travelport followed soon thereafter.
- On behalf of DuPont, provided economic analysis and expert testimony in a monopolization case related to sales of para-aramid fiber (e.g., Kevlar) in the United States. Kolon, a para-aramid supplier, alleged that the use of certain supply agreements between DuPont and some of its customers was illegal exclusionary conduct under Section 2 of the Sherman Act. Provided expert testimony showing that DuPont is not a monopolist in para-aramid fiber and the supply agreements at issue are not detrimental to competition. DuPont was granted summary judgment in its favor and Kolon Industries' antitrust claims were dismissed with prejudice.
- Supported multiple testifying experts retained by counsel for Advanced Micro Devices (AMD) in litigation against Intel, Inc., alleging illegal conduct to maintain a monopoly. Led teams working on issues of market definition, monopoly power, and consumer harm. Led the damages expert support team in the rebuttal phase. Assisted with

deposition preparation. Before the case was brought to trial, AMD and Intel agreed to a $1.25 billion settlement that included restrictions on certain business practices.

- Supported multiple testifying experts on behalf of direct and indirect plaintiffs in *In re Dynamic Random Access Memory (DRAM) Antitrust Litigation*. Served as the lead econometrician and worked closely with the liability expert to write affirmative and rebuttal expert reports and prepare for deposition. Collaborated with counsel throughout the discovery process in preparing interrogatories, document requests, and drafting deposition questions on core economic issues.
- Worked with an expert in the consumer credit scoring business to analyze market definition and competitive effects including the evaluation of potential efficiencies in a matter alleging exclusionary conduct.

B.5. Selected merger experience

- On behalf of construction material manufacturers Holcim Ltd. and Lafarge SA, provided economic analysis of the likely competitive effects of the proposed $25 billion merger in markets for cement, ready-mix concrete and construction aggregates in North America, analyzed various divestiture scenarios, and provided ongoing support to attorneys for the parties throughout the regulatory approval process. The analysis was presented in two written submissions to the FTC and two written submissions to the Canadian Bureau of Competition (CBC). After almost one year of review, the FTC and CBC approved the merger, pending certain asset divestitures.
- Conducted detailed economic analysis on behalf of Eli Lilly in connection with its $5.4 billion acquisition of Novartis Animal Health. Both firms were active in developing and marketing animal health products, including medications used to treat pets and livestock. Bates White assessed overlaps in several areas, and presented results of its analysis to the FTC. The FTC approved the merger after an eight month investigation, with divestiture required in one product area, canine parasiticides.
- Worked on behalf of Dr. Oetker to analyze the competitive effects of its proposed acquisition of McCain Foods' North American frozen pizza business. Submitted

analysis to the Competition Bureau of Canada, who cleared the acquisition without the issuance of a supplemental information request.

- Supported Telefónica in its recent takeover of E-Plus in Germany. Studied the relationship between concentration and price levels in different European mobile markets.
- Retained by a cable TV company to research the effects of television station blackouts on television viewing patterns and cable subscriber turnover, and to evaluate the effects of mergers of local broadcasters on retransmission consent rates.
- Retained to testify on statistical issues in the matter *Federal Trade Commission v. St. Luke's Health System, Ltd.*
- Provided economic analysis and expert support for the Competition Bureau of Canada's evaluation of a proposed merger of equities exchanges and related entities, including the Toronto Stock Exchange.
- Provided economic analysis of AT&T's proposed acquisition of T-Mobile, which raised both horizontal and vertical concerns.
- On behalf of the Canadian Competition Bureau, addressed concerns about possible effects of BHP Billiton's proposed acquisition of Potash Corporation of Saskatchewan. Analyzed market definition, merger efficiencies, and possible unilateral and coordinated effects on competition.
- Worked on behalf of a supply chain logistics company with concerns about foreclosure effects from a proposed vertical merger. Assisted client with presentations to the Federal Trade Commission.
- Conducted economic analysis on behalf of a video programming distributor about vertical foreclosure issues and other possible effects arising from the merger of Comcast and NBC Universal. Assisted the client in meetings with Department of Justice.
- Worked with an academic affiliate on behalf of Dr. Oetker Brasil to provide analysis of its concerns about issues arising from the merger of Sadia and Perdigão to form Brasil Foods. Drafted a white paper for Brazilian competition authorities evaluating claims

about likely effects of the merger on markets for frozen pizza, and possible vertical foreclosure issues in frozen food distribution in Brazil.

- Provided economic consulting support to Delta Air Lines and Northwest Airlines in connection with their proposed merger under investigation by the Department of Justice (DOJ). Identified antitrust risks, analyzed price effects, and developed a retrospective merger analysis for the airline industry.
- Supervised the analysis presented to the FTC on the antitrust implications of The Great Atlantic & Pacific Tea Company's (A&P) proposed acquisition of Pathmark Stores, Inc. on behalf of A&P. Analysis considered the impact of the entry and exit of nearby supermarkets, grocery stores, mass merchandisers, clubs, and other food retailers on prices, margins, and sales. Provided significant assistance to attorneys in responding to second request from the FTC. The FTC ultimately allowed A&P to acquire Pathmark, requiring Pathmark to divest only six of its 141 stores.
- Served as consulting expert and performed market definition and market share analyses on behalf of a hospital system considering a proposed merger. Analysis also considered the effect of various alternative merger scenarios and what effect, if any, they might have on market concentration in the relevant geographic area. Our findings helped the hospital system with its decision not to pursue a merger at this time.
- Supervised the analysis presented to the FTC on behalf of a leading provider of pharmaceutical benefits management services in connection with its proposed acquisition of a competitor. Assisted with response to second request and presented analysis of bid data on likely competitive impact in multiple customer segments.
- Provided a client in the hospital industry with antitrust and industry expertise to assist it and DOJ in investigating alleged anticompetitive conduct by competing firms. Investigations involve complex issues of horizontal and vertical market foreclosure.
- Worked extensively with attorneys and testifying expert in *Federal Trade Commission v. Western Refining*. Directed econometric analysis to support expert report, deposition, and trial testimony regarding market definition and likely competitive effects of a merger between two refiners of light petroleum products.

- Worked on analysis related to DOJ's investigation of Monsanto's proposed acquisition of Delta and Pine Land that raised both horizontal and vertical concerns in the agricultural biotechnology industry. Supervised independent research and data analysis and drafted presentations made to DOJ.
- Appeared before the Federal Trade Commission on behalf of Batesville Casket Company, a leading firm in the death care industry, in connection with a merger that raised both horizontal and vertical concerns. Presented statistical analysis of natural experiments and previous mergers. FTC's second request investigation was closed without any divestitures being required.
- On behalf of a leading distributor of wine and spirits, analyzed likely effects of a horizontal merger reviewed by the Federal Trade Commission and state authorities. The analysis included a retrospective merger analysis and empirical analysis of other natural experiments.
- Provided expert support in connection with the DOJ's investigation of the CME/CBOT merger, including empirical analyses of candidate competitive effects theories.

B.6. Selected Department of Justice experience

- Developed strategy, performed case analysis, assisted with depositions, and reviewed expert reports in *United States v. Dentsply International, Inc*. Worked extensively with economic experts on empirical analysis and a survey design and analysis. Worked with economic expert to refine and evaluate econometric models used to estimate price and quantity effects of exclusive dealing.
- Performed case analysis in *United States and Plaintiff States v. EchoStar Communications Corp.*, which challenged the proposed merger of satellite television providers DirecTV and Dish Network, the only two nationwide providers of multichannel video programming delivery (MVPD) services at the time. Worked on evaluation of defendant econometric model to assess likelihood of consumer harm with full accounting for claimed cost savings and other efficiencies, and projected quality improvements.

- Developed strategy, performed case analysis, assisted with depositions, and reviewed expert reports in *United States v. Visa USA. Inc.*, a monopolization matter.
- Assumed primary responsibility for financial market data analysis, and shared responsibility for economic analysis for the US Department of Justice investigation leading to filing and settlement of the landmark antitrust case *United States v. Alex. Brown & Sons.* As a result of this litigation, 24 major NASDAQ securities firms were charged with practices leading to inflated stock transaction fees.
- Worked closely with economic experts and officials at the Securities and Exchange Commission in *United States v. American Stock Exchange, LLC*. Performed econometric analysis quantifying increased options trading costs arising from illegal agreements between the options exchanges. Final resolution required the options exchanges to cease anticompetitive conduct and to restructure the industry to increase competition.
- Worked extensively with attorneys and economic experts in *United States v. First Data Corp.* Provided support for depositions of opposing experts.
- Conducted demand and merger simulation modeling and analysis involving the extensive use of scanner data and the evaluation of survey data in multiple merger matters involving consumer products.
- Analyzed the deficiencies in scanner data and identified additional data sources to address incomplete coverage of scanner data in a case involving the merger of two leading cosmetic companies.
- Worked with an expert to develop and execute consumer surveys used to assess demand, analyze and critique surveys, and perform demand modeling in *United States and the State of Colorado v. Vail Resorts, Inc.* Analysis included extensive revisions and extensions of econometric models.
- Analyzed scanner data, performed demand estimation and modeling, and performed merger effects analysis and merger simulation modeling in *United States v. Georgia-Pacific Corp.* Also considered efficiency arguments in the case and prepared to provide expert testimony; case settled prior to trial.

- Analyzed scanner data, performed demand estimation and modeling, and performed merger effects analysis and merger simulation modeling in *United States v. Kimberly-Clark Corp.*
- Prepared as potential testifying expert in *United States v. Primestar, Inc*. Prepared econometric estimation for rebuttal of economic experts. Modeled and analyzed penetration rates.
- Provided case analysis, conducted interviews, assisted in preparation of expert reports, assisted in depositions and trial preparations and conduct of the trial in *United States v. Long Island Jewish Medical Center*.

B.7. Publications

- Thompson, T. Scott. "ACA Exchange Premiums and Hospital Concentration in California." *ABA Antitrust Health Care Chronicle* 28, no. 1 (2015): 27–34.
- Rozanski, George A. and T. Scott Thompson. "Issues in the Analysis of Buyer Power in Agricultural Markets." ABA Antitrust Law Section (March 2011).
- Thompson, T. Scott. "Out-of-network involuntary medical care: An analysis of emergency care provisions of the Patient Protection and Affordable Care Act." White paper for America's Health Insurance Plans, August 2010. http://www.bateswhite.com/insight.php?NewsID=113.
- Emch, Eric R. and T. Scott Thompson. "Market Definition and Market Power in Payment Card Networks." *Review of Network Economics* 5, no. 1 (2006): 45–60.
- Rozanski, George A. and T. Scott Thompson. "Use of Econometrics at the U.S. Department of Justice." In *Econometrics: Legal, Practical, and Technical Issues*, edited by the ABA Section of Antitrust Law, 131–65. Chicago: ABA Publishing, 2005.
- Ichimura, Hidehiko and T. Scott Thompson. "Maximum Likelihood Estimation of a Binary Choice Model with Random Coefficients of Unknown Distribution." *Journal of Econometrics* 86, no. 2 (1998): 269–95.

- Thompson, T. Scott. "Some Efficiency Bounds for Semiparametric Discrete Choice Models." *Journal of Econometrics* 58, nos. 1–2 (1993): 257–74.
- Thompson, T. Scott. "Equivalence of Direct, Indirect, and Slope Estimators of Average Derivatives: A Comment." In *Nonparametric and Semiparametric Methods in Econometrics and Statistics*, edited by Barnett, William A., James Powell, and George Tauchen, 119–26. New York: Cambridge University Press, 1991.
- Manski, Charles F. and T. Scott Thompson. "Estimation of Best Predictors of Binary Response." *Journal of Econometrics* 40, no. 1 (1989): 97–123.
- Manski, Charles F. and T. Scott Thompson. "Operational Characteristics of Maximum Score Estimation." *Journal of Econometrics* 32, no. 1 (1986): 85–108.
- Baldwin, Robert E. and T. Scott Thompson. "Responding to Trade-Distorting Policies of Other Countries." *American Economic Review* 74, no. 2 (1984) 271–6.
- Ginsberg, Paul B., Lawrence A. Wilson, and T. Scott Thompson. "The CBO Hospital Cost Containment Model: A Technical Analysis." Congressional Budget Office, US Congress, Washington, DC, 1981.

B.8. Selected speaking engagements

- "Counseling clients on exclusionary conduct: lessons from *AMD v. Intel*." Presentation to the Antitrust Section, New York State Bar Association. March 2011.
- "Antitrust activity in card-based payment systems: causes and consequences." Invited presenter, Federal Reserve Bank of New York and the Review of Network Economics. September 2005.
- "Public workshop on estimating the price effects of mergers and concentration in the petroleum industry: an evaluation of recent learning." Invited panelist, Federal Trade Commission. January 2005.
- Joint FTC/DOJ hearings on health care and competition law and policy. Panel moderator. April 2003.

- Joint meeting of European community and US Antitrust Agency economists on methodological aspects of recent enforcement activities. Case presentation. October 2004.
- Economist training session on GMM estimation. US Department of Justice Antitrust Division and Federal Trade Commission Bureau of Economics. December 2001.
- Attorney training workshop on elementary econometrics. US Department of Justice Antitrust Division. March 2001.
- Department of Economics, University of British Columbia, Vancouver. Seminar presentation. February 1994.
- Department of Statistics, North Carolina State University. Seminar presentation. June 1994.
- Joint statistical meetings, American Statistical Association. Paper presentation. August 1994.
- Department of Economics, University of Wisconsin-Madison. Seminar presentation. December 1994.
- NSF conference on semi- and non-parametric econometrics. Yale University. April 1993.
- Department of Economics, University of Chicago. Workshop presentation. April 1993.
- North American summer meetings of the Econometric Society. Paper presentation. June 1992.
- Research Triangle Econometrics workshop. Workshop presentation. Duke University. Fall 1991.
- CORE conference on discrete choice modeling. Invited paper presentation. Université Catholique de Louvain. October 1990.
- CORE econometrics workshop. Seminar presentation. Université Catholique de Louvain. October 1990.

B.9. Honors and awards

- Assistant Attorney General's Distinguished Service Award, US Department of Justice, Antitrust Division, 2001.
- University of Minnesota Supercomputer Institute Computer Resources Grant. "A Resampling Statistical Test for Normality in the Random Coefficients Model of Binary Choice," 1993.
- University of Minnesota Supercomputer Institute Computer Resources Grant. "Algorithms for Computation of Semiparametric Discrete Choice Estimators," 1993.
- University of Minnesota Supercomputer Institute Computer Resources Grant. "Monte Carlo Evaluation of Statistical Methods for Random Coefficient Models" (with Hidehiko Ichimura), 1992.
- National Science Foundation Grant, 1991–1992.
- University of Minnesota Graduate School Summer Research Fellowship, 1989.

B.10. Referee service

- Econometric Reviews
- Econometric Theory
- Econometrica
- International Economic Review
- Journal of Business and Economic Statistics
- Journal of Econometrics
- Journal of Human Resources
- Journal of the American Statistical Association
- Journal of the Japanese and International Economies
- Proceedings of the Fifth International Symposium on Economic Theory and Econometrics

- National Science Foundation Grant Reviews